Repair of post-infarction left ventricular free wall rupture using an extracellular matrix patch

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CASE REPORT

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Repair of post-infarction left ventricular free wall rupture using an extracellular matrix patch

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Abstract

Several techniques for surgical treatment of acute or subacute left ventricular free wall rupture (LVFWR) have been described using a sutured or sutureless patch with different currently available materials. We present a case report of a 50-year-old male with acute LVFWR, who was treated with a simple surgical technique using an 'off-pump' epicardially sutured LV patch consisting of an acellular xenogeneic extracellular matrix (ECM). ECM patches are structurally more surgeon-friendly and have shown to be bioactive, and capable of activating remodelling and even tissue regeneration. Compared with conventional pericardial patches, the advantage of this material is excellent pliability and very easy stitching owing to the thin composition of the material. In addition, and most importantly, in case of complex structural reconstructions, the patch is highly tear-proof.

Keywords: Left ventricle • Myocardial infarction • Off-pump surgery

INTRODUCTION

Since the advent of percutaneous coronary intervention (PCI) left ventricular free wall rupture (LVFWR) is nowadays a very rare and uncommon complication following acute transmural myocardial infarction; however, LVFWR has very high mortality rates (5–24% of all in-hospital deaths) due to both the severity of disease and the complexity of surgical management. Although the majority of patients die immediately after rupture, the survivors basically present with three different courses of the rupture: catastrophic 'blow-out', subacute 'oozing' and chronic 'false aneurysm' types.

Despite the few reports of percutaneous intrapericardial fibrin-glue injection therapy as a new treatment alternative for cases with 'oozing' type LVFWR, emergency surgical repair is considered the gold standard therapy. Several surgical techniques have been described [1–3]; yet which technique and material should be used still remains controversial. One option is to treat the rupture with an epicardially sutured patch in the beating heart without the use of cardiopulmonary bypass. We report a simple technique for treatment of LVFWR with an epicardially sutured LV patch using an acellular xenogeneic extracellular matrix (ECM) in order to identify a new material, which would be more surgeon-friendly, biocompatible and bioresorbable, and show remodelling and even tissue regeneration [4, 5].

CASE PRESENTATION

A 50-year-old male was referred to our department, presenting with cardiogenic shock due to the acute transmural myocardial infarction of the posterior wall, which was treated by PCI of the circumflex artery. Consequently, LVFWR was suspected and the pericardium was drained with the pigtail catheter. An emergency echocardiography revealed the LVFWR (Fig. 1A and B) and an emergency operation was indicated.

After induction of general anaesthesia, an intra-aortic balloon pump (IABP) was placed via the right femoral artery to stabilize the patient's haemodynamics and to reduce the LV wall stress. Following median sternotomy and opening of the pericardium, a large clot was removed from the pericardial space. The heart was elevated for inspection using a modified 'Lima' pericardial traction stitch without the use of cardiopulmonary bypass. A region with an epicardial haematoma was identified in the inferolateral wall, and a small tear with visible ventricular muscle fibres was found in the infarcted area (Fig. 2A). One sheet (7 × 10 cm) of a xenogeneic ECM membrane (CorMatrix ECM®, CorMatrix Cardiovascular, Inc., Atlanta, GA, USA) was trimmed and sutured with a running polypropylene 4-0 suture around the infarcted area covering the LV rupture and creating a pouch (Fig. 2B). For reinforcement, the created pouch was filled with 5 ml gelatine–resorcinol–formaldehyde glue (GRF® glue; Cardial-Bard, Sainte-Etienne, France) (Fig. 2C and D). Additionally, a saphenous vein segment was grafted to the

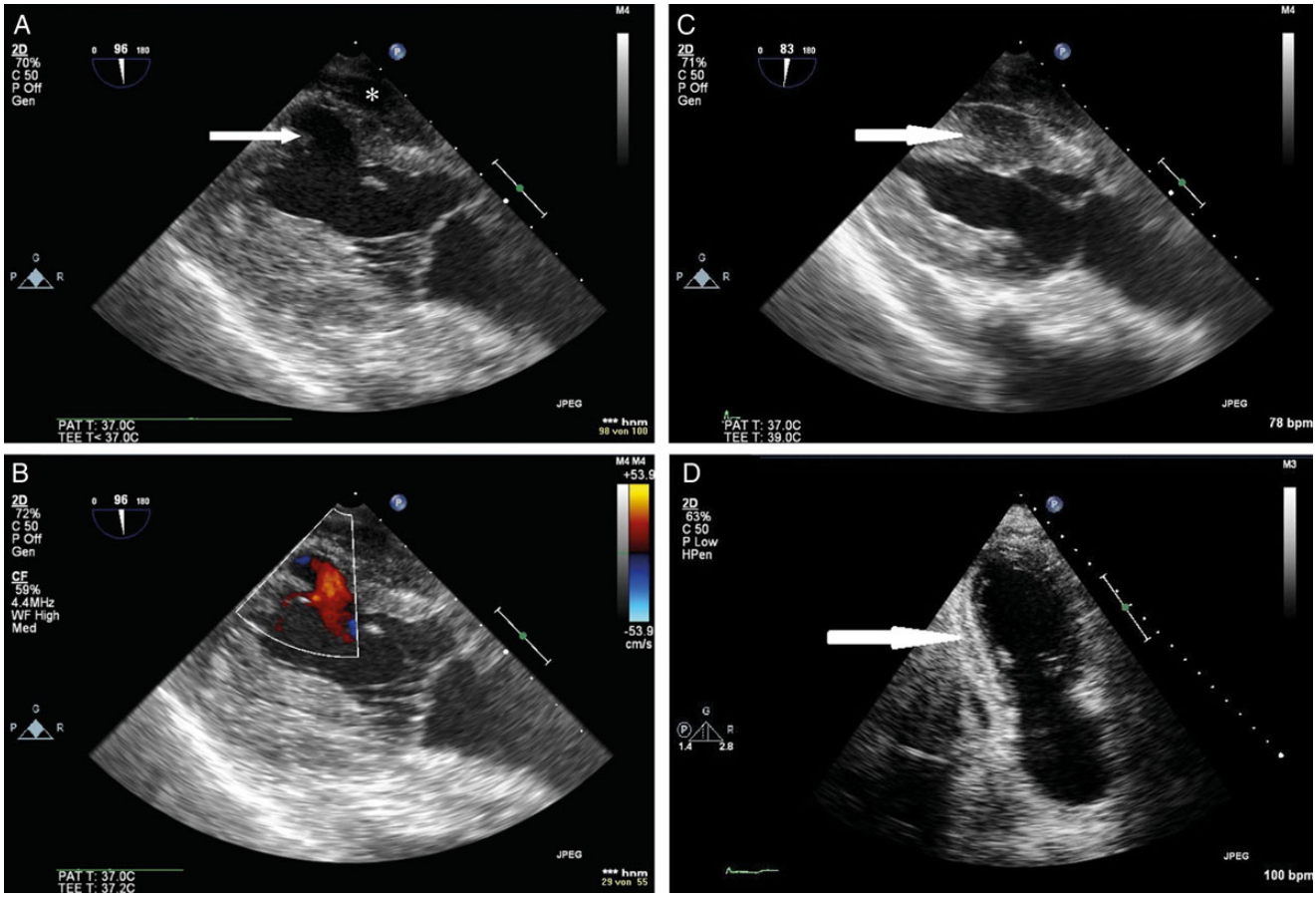


Figure 1: (**A**) Preoperative transoesophageal echocardiogram (transgastric long-axis view) showing an inferolateral left ventricular free wall rupture with a cavity created in the myocardium (white arrow) and an intrapericardial haematoma due to the lesion (asterisks). (**B**) Preoperative transoesophageal echocardiogram (transgastric long-axis view) with colour Doppler demonstrating the created rupture cavity in the myocardium washed by the blood stream. (**C**) Immediate postoperative transoesophageal echocardiogram (transgastric long-axis view) showing the inferolateral left ventricular free wall with the former myocardial cavity filled with GRF® glue and covered by epicardial CorMatrix ECM® patch (white arrow). (**D**) Three-month postoperative transthoracic echocardiogram (apical two-chamber view) showing the former inferolateral left ventricular free wall rupture with no more evidence of GRF® glue and epicardial CorMatrix ECM® patch. The hyperdense area is representing scarring/remodelling myocardial tissue (white arrow). GRF® glue: gelatine–resorcinol–formaldehyde glue; ECM: extracellular matrix.

posterior descending artery. After placement of drainage tubes, the chest was closed in standard fashion and the IABP was left in place until the second postoperative day for afterload reduction and consequently reducing the wall stress on the patched area.

The patient recovered very well from the operation, was easily weaned from IABP and extubated on the third postoperative day. The postoperative course was then complicated by the perforation of a sigmoid colon diverticuli requiring a resection of the sigmoid colon via median laparotomy.

The early postprocedural transoesophageal echocardiography in the operating room showed a good result with normal LV size and an LVEF of 45% with inferoseptal akinesia (Fig. 1C, Video 1). The follow-up transthoracic echocardiography during his uneventful postoperative period and three months after operation demonstrated an excellent result with normal LV size and an LVEF of 50% with inferolateral and septal hypo-/akinesia (Fig. 1D, Video 2).

DISCUSSION

Several techniques for surgical treatment of acute or subacute LVFWR have been described using a sutured or sutureless patch with different currently available materials [1–3]. Which technique and especially which material should be used are still not established. The most frequently used patches are made from autologous pericardium or xenopericardium; however, they generally undergo calcification and degradation in the long term. Other options are synthetic materials like Dacron or expanded polytetrafluoroethylene. These materials are not biocompatible and their low pliability may be of technical disadvantage, especially in the beating-heart technique.

An acellular porcine small intestinal submucosa-derived ECM has been successfully introduced to surgery as a new substitute material for different applications in order to sustain biocompatibility and potentially bioactivity, remodelling and even tissue regeneration. The tissue remodelling and regeneration of this material has been demonstrated in preclinical experiments [4]. Recently, this material has also successfully been introduced for structural reconstruction in cardiac surgery [5]. Histological examination of explanted ECM patches showed resorption and no calcification of the material as well as replacement with organized collagen and re-endothelialization [5].

This report demonstrates the acellular xenogeneic ECM membrane as a convenient alternative material to synthetic or

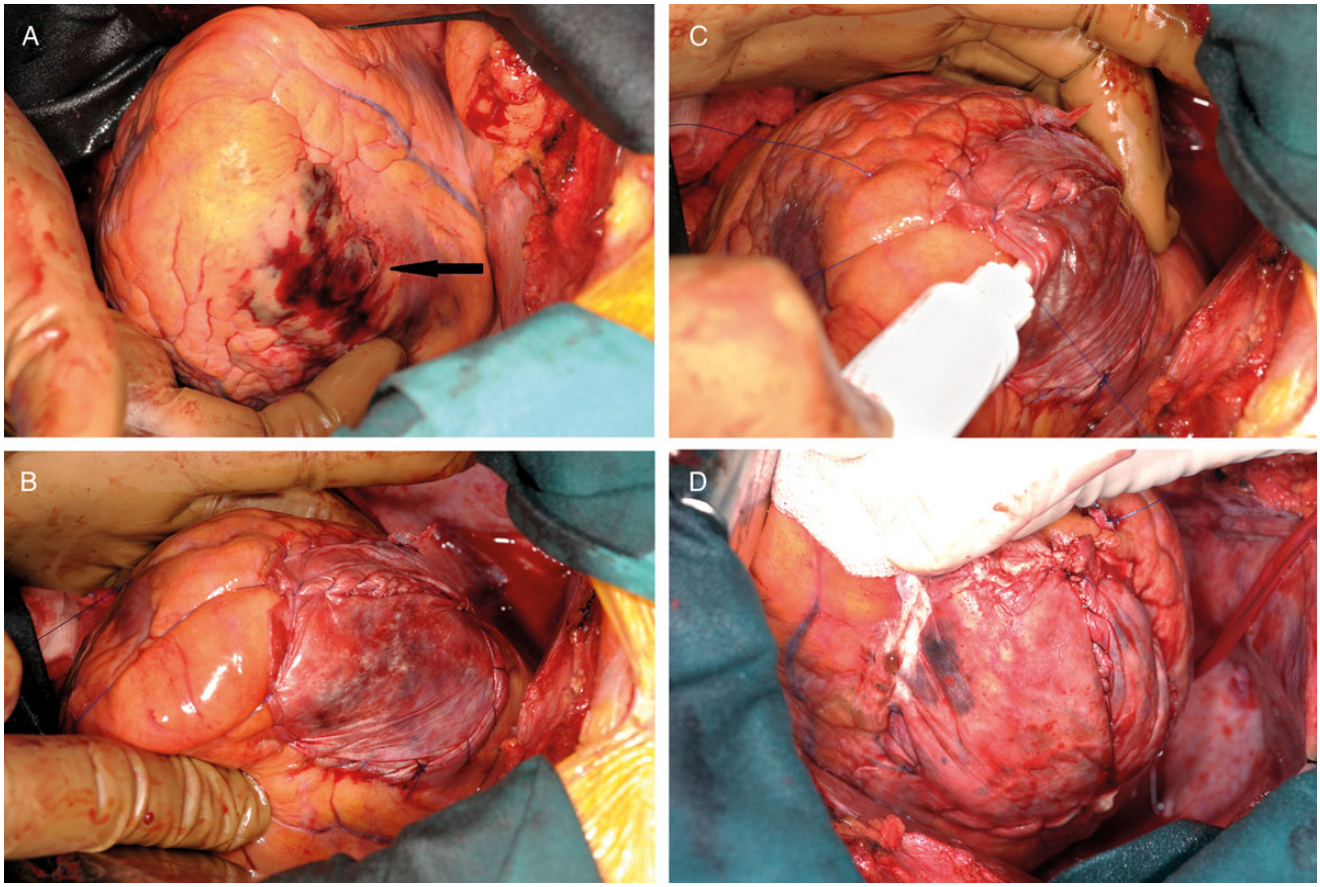
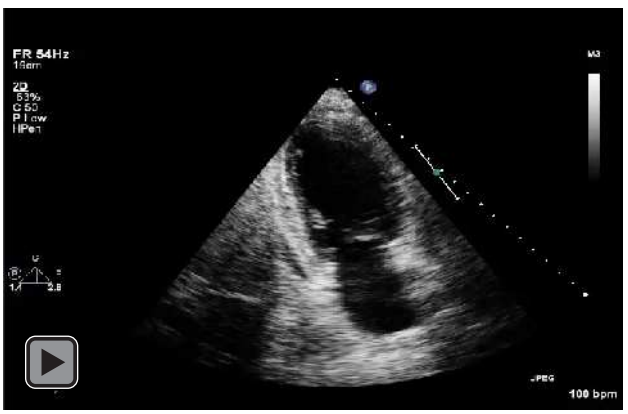


Figure 2: (**A**) Intraoperative image showing a rupture of the inferior left ventricular free wall (arrow) in the distal region of the circumflex artery. (**B**) The CorMatrix ECM® patch is sutured with a running polypropylene suture by the off-pump technique on the inferior left ventricular wall, creating a pouch. (**C**) The created pouch is filled with GRF® glue to reinforce the sutured patch over the ruptured left ventricular free wall. (**D**) The final image of the reinforced CorMatrix ECM® patch sutured on the inferior left ventricular free wall. GRF® glue: gelatine–resorcinol–formaldehyde glue; ECM: extracellular matrix.

Video 1: Immediate postoperative transoesophageal echocardiogram (transgastric long-axis view) showing normal left ventricular (LV) size and LV EF of 45% with inferolateral akinesia in the area of the former myocardial cavity filled with GRF® glue and covered by epicardial CorMatrix ECM® patch. GRF® glue: gelatine–resorcinol–formaldehyde glue; ECM: extracellular matrix.



Video 2: Three-month postoperative transthoracic echocardiogram (apical two-chamber view) demonstrating normal LV size and LV EF of 50% with inferolateral hypo-/akinesia in the area of the former LV free wall rupture. The hyperdensity area represents a scarring/remodelling myocardial tissue with no evidence of GRF® glue and the epicardial CorMatrix ECM® patch. GRF® glue: gelatine–resorcinol–formaldehyde glue; ECM: extracellular matrix.

pericardial substitute materials for the epicardial patch technique to treat LVFWR, even when performed with an off-pump beating-heart technique. Compared with conventional pericardial patches, the advantage of this material is its excellent pliability and therefore resulting in a lesser risk of tearing of the myocardium as well as very easy stitching owing to the thinness of

the material. Bleeding prevention seems easier with this material because the margins of the patches adapt much better than bovine pericardium does. Despite its thinness, the patch is highly tear-proof. The combination of suturing the CorMatrix ECM® patch to the epicardium and additional use of a sealant seems to be a very good option especially for haemostasis; however, a sutureless direct gluing of this patch might also be an option.

At follow-up, the LVEF increased when compared with the early postoperative period, suggesting possible tissue regeneration. The potential bioactivity and remodelling or even tissue regeneration of the material in this clinical application have to be proven by longer-term results.

Conflict of interest: none declared.

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